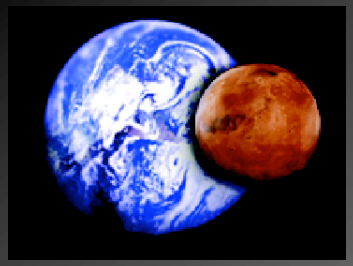


Mars Upper Atmosphere Dynamics & Structure (MUADS)

Jeffrey M. Forbes, University of Colorado

Science Objectives

- Characterize the temperature, density and wind structures of Mars' upper atmosphere (UA), 25-200 km
- Understand the sources of variability of Mars UA.
- Understand how wave-wave interactions, wave-mean flow interactions, and wave dissipation contribute to the mean state and variability of Mars' and Earth's UA.

Objectives to Support Manned Exploration

- Define the aerobraking and aerocapture environments for Mars exploration spacecraft.
- Provide the data required to constrain GCMs and to develop assimilation-based atmospheric models that support the manned exploration effort.

Enabling and Enhancing Technology Development

- Low Mass/Power Instrumentation
- Miniaturized Cryogenics

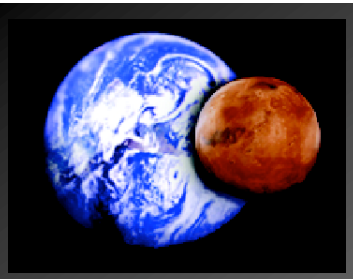
Mission Description

- ~500 km circular orbit
- Medium-inclination to allow local time precession (at least 24 hours per season)
- 1 year flight time - 1 Mars year operations

Measurement Strategy

- Broadband Emission Radiometer, i.e., SABER instrument on TIMED (temp, density, pressure, CO_2 density and emissions; constituents)
- Doppler Interferometer, similar to the TIDI instrument on TIMED and HRDI instrument on UARS (temperature, winds, airglow emissions)
- Accelerometer

MUADS is distinct from the Mars Aeronomy mission, which is focused on those dynamical and chemical processes involved with solar wind-ionosphere interaction, and the fate of water vapor and other atmospheric constituents over Mars' history.



Mars Upper Atmosphere Dynamics & Structure (MUADS)

Jeffrey M. Forbes, University of Colorado

Mission: Explore and define the temperature, density and wind structure of Mars atmosphere, 25-200 km.

The mean state and variability of Mars upper atmosphere (UA) is strongly driven by upward-propagating solar-driven thermal tides excited in the lower atmosphere, solar radiative forcing, CO_2 cooling, and during some seasons, dust storms. Upper atmosphere variability below 200 km due to solar wind effects is small.

In the above sense, Mars' upper atmosphere is driven by the same processes as Earth's upper atmosphere during solar minimum, when geomagnetic forcing is at a minimum. The effects of large-scale waves on Mars upper atmosphere is in fact considerably larger than that on Earth. (The effects of small-scale waves, i.e., gravity waves, is thought to be important, too, but is out of the scope of the MUADS mission).

Many key aspects of UA dynamics on both Earth and Mars are poorly understood, such as wave-wave coupling, wave-turbulence coupling, wave-mean flow interactions, the effects of radiative cooling on waves, etc. A comparative planetary study of these processes on Earth and Mars is scientifically synergistic, and will also lead to improved understanding of similar processes on Venus and the outer planets.

***Further, MUADS measurements are required in order to adequately define and ultimately predict the aerobraking and aerocapture environments for manned exploration of Mars*. Such measurements will be used to (a) construct empirical models; (b) constrain Mars GCMs; and (c) form a database for data assimilation efforts.**

At present, there are no wind measurements in Mars UA, no satellite-based temperature measurements above 50 km, and no density measurements, except for a few entry probes and accelerometer data between 100-150 km from MGS and Odyssey. All of the available data are extremely limited in season, latitude and local time.